

Application No. 10/660,477
Amendment dated January 5, 2006
Reply to Office Action of October 5, 2005

Docket No.: 20140-00303-US1

REMARKS

Claims 1-48 remain pending in this application. Claims 1, 9, 16, and 23 are independent. Claims 29-42 are multiple dependent claims. No claims have been added or canceled by this Amendment. Independent claims 1, 9, 16, and 23 have been amended.

Enablement Rejection Under §112¶1

Withdrawal of the rejection of claims 43-48 as failing to comply with the enablement requirement is requested. The Examiner asserts that it is unclear how a "harmonic conversion cell" operates using rare gases to tune a wavelength.

Applicants submit that a person of ordinary skill in the art would have appreciated the operation and underlying physics of such devices at the time this application was filed, even though the detailed operation of a harmonic conversion cell is not necessary to make and use the claimed invention.

This is particularly true when the person of ordinary skill in the art is aware of Applicants' disclosure. For example, paragraph [0040] of the pending application discloses (*emphasis added*):

[0040] The repair process using the exemplary apparatus 600 in FIG. 6 includes several steps. As illustrated in FIG. 6, laser light pulses 620 from amplified femtosecond laser 610, typically operating at 800 nm at a repetition rate of 1kHz, is focused through an optical pathway including, for example, beam control unit 670, mirror 631, focusing lens 632, and window 633 *into a rare gas harmonic converter cell 640 containing, for example, gases such as Kr, Ar, Ne or He. The interaction of the intense laser light 620 and the gas in cell 640, along the focal plane of the laser system, is sufficient to produce harmonics of the fundamental 800 nm wavelength.* Individual harmonics may be chosen by using filter 650. Filter 650 can be a series of multilayer coated mirrors which reject all but the desired harmonic wavelength 660. Other selective wavelength filters may include reflective diffraction gratings, and thin metal foils, for example. *Additionally, desired harmonics may be selected by tuning of the harmonic gas pressure in cell 640,* or by tuning other aspects of the light generation process including, for example, using beam control unit 670. Beam control unit 670 may also contain diagnostic equipment for evaluating the performance of laser apparatus 600.

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A confirmatory example of this phenomena used to obtain extreme ultraviolet (EUV) from rare gas conversion cells similar to that disclosed in and enabled by the present application may be found as an attachment to this response.¹

To summarize the attached article, the process used to produce the EUV is called high-order harmonic generation, i.e., light at visible or near IR wavelengths enters a sample of helium atoms, for example, and temporarily strips the outer electron from the atom. This electron then quickly rejoins its atom, emitting a higher-energy (harmonic) photon in phase with the original light. In other words, the atom is used to convert visible/near IR light into higher-energy light.

Noble gas atoms are useful for this harmonic process since their outer electrons are grasped tightly, but if such electrons can be stripped, they will provide a high-energy photon. Helium (the smallest noble element) emits harmonic photons at energies even higher than that obtainable from argon, but with some difficulty. Argon is generally chosen because the harmonic conversion of light is much more efficient.

Accordingly, Applicants submit that a person with skill in the art would appreciate the operation of and would be capable of making and using Applicants' invention as variously claimed in claims 43-48.

Reconsideration and allowance of claims 43-48 are respectfully requested.

Unpatentability Rejection over Corkum et al., Zait et al. and Karasaki

Withdrawal of the rejection of claims 1-42 under 35 U.S.C. 103(a) as being unpatentable over Corkum et al. (U.S. Patent Application Publication No. 2003/0111447) in view of Zait et al. (WO 03/022506 A1) and Karasaki (JP 63-49388) is requested.

At the outset, Applicant notes that, to establish a *prima facie* case of obviousness, three basic criteria must be met. First, there must be some suggestion or motivation, either in the references themselves or in the knowledge generally available to one of ordinary skill in the art,

¹ "Physics News Update - The AIP Bulletin of Physics News", Number 670 #1, January 22, 2004 by Phil Schewe, James Riordon, and Ben Stein, available on the internet at <http://www.aip.org/pnu/2004/split/670-1.html>.

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to modify the reference or to combine reference teachings. Second, there must be a reasonable expectation of success. Finally, the prior art reference must teach or suggest all the claim limitations.² Further, the teaching or suggestion to make the claimed combination and the reasonable expectation of success must both be found in the prior art, not in applicant's disclosure.³

Discussion of Corkum et al.

Corkum et al. arguably teaches a method of ablating material from a surface of or from within a powered and operating microelectronic or opto-electronic component by using Femtosecond laser pulses to repair structural defects in the powered electronic device. Corkum et al. is silent on repair of other types of unpowered devices, and is also silent n use of EUV laser pulses.

Contrary to the Examiner's assertion, Corkum et al. is completely silent on repair of lithographic photomasks (including reflective photomasks) as the examiner states on page 3 of the Official Action. Corkum et al. is directed solely to using femtosecond lasers to repair operating electronic circuits, and there clearly is no overlap whatsoever with Applicants' claimed invention.

Discussion of Zait et al.

Zait et al. is arguably directed to the use of an ultrashort pulse laser ablation apparatus and method to form reticles for photolithography. This reference describes using a femtosecond pulse to ablate an absorber from a photomask in a manner at least similar if not essentially identical to a number of IBM patents relating to the use of femtosecond laser light pulses to ablate the photomask defects.

In addition Zait et al. does not teach or suggest, as the examiner asserts on page 10 of the Official Action, the use of multilayer coatings. What Zait et al. teaches are the layers of resist, Cr or molybdenum silicide (MoSi) that are present on any run of the mill commercial photomask.

² See MPEP §2143.

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By way of background, photomasks come with the absorber (Cr or MoSi) coated with a resist, either e-beam or optical, so that a circuit pattern can be written. Nonetheless, Zait et al. does not address the multilayer issue that Applicants do in the present application.

In the present application, the multilayer is a dielectric multilayer for high reflectivity which translates into a metal or metal/semiconductor multilayer in the vacuum ultraviolet (VUV) or extreme ultraviolet (EUV) wavelength region. These are completely different multilayers from any that might be taught by Zait et al.

Discussion of Karasaki

As can best be determined from the limited English language abstract, Karasaki is directed to a laser beam machine having the purpose of decreasing the reflected laser light and to execute efficient processing by providing an element for modulating the wavelength of the laser light to the wavelength of a low reflectivity in conformity with a processing material. The laser wavelength modulating element 6 is installed between the output mirror 1 in the oscillator and the torch 5 to convert the wavelength of the laser light to the wavelength of the low reflectivity material being processed.

Lack of Motivation to Combine

Applicants submit that a person of ordinary skill in the art would not be motivated to combine the teachings of Corkum, Zait and Karasaki in the manner suggested by the Examiner to the repair of photomasks (reflective photomasks or otherwise) or, alternatively, to use EUV light to ablate undesired material.

An essential evidentiary component of an obviousness rejection is a teaching or suggestion or motivation to combine the prior art references.⁴ Combining prior art references

³ *In re Vaack*, 947 F.2d 488, 20 USPQ2d 1438 (Fed. Cir. 1991) and *See* MPEP §2143.

⁴ *C.R. Bard, Inc. v. M3 Systems, Inc.*, 48 USPQ2d 1225 (Fed. Cir. 1998)

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without evidence of a suggestion, teaching or motivation simply takes the inventors' disclosure as a blueprint for piecing together the prior art to defeat patentability – the essence of hindsight.⁵

“There are three possible sources for a motivation to combine references: the nature of the problem to be solved, the teachings of the prior art, and the knowledge of persons of ordinary skill in the art.”⁶ Further with regard to the level of skill of practitioners in the art, there is nothing in the statutes or the case law which makes “that which is within the capabilities of one skilled in the art” synonymous with obviousness.⁷ The level of skill in the art cannot be relied upon to provide the suggestion to combine references.⁸

None of the references provide the stated motivation, and Applicants submit that the only basis for the Examiner's stated basis for motivation is by improper hindsight analysis, using Applicants' disclosure against them.

Accordingly, a *prima facie* case of unpatentability has not been made at least on this basis.

Specific Deficiencies of the Applied Art

The applied art, taken alone or in combination, does not teach or suggest a method of selectively ablating material which includes, among other features, “...providing visible or near-IR wavelength laser light; [and] converting the visible or near-IR wavelength laser light to extreme ultraviolet (EUV) wavelength laser pulses...”, as recited in independent claim 1, as amended.

In addition, the applied art, taken alone or in combination, does not teach or suggest a method of producing an essentially defect-free photomask for semiconductor applications, which includes, among other features, “...providing a substrate including a surface having an absorbing layer patterned thereon as a mask to yield a circuit when transferred to a resist coated

⁵ *Interconnect Planning Corp. v. Feil*, 227 USPQ 543 (Fed. Cir. 1985)

⁶ See MPEP §2143.01, citing *In re Rouffet*, 149 F.3d 1350, 1357, 47 USPQ2d 1453, 1457-8 (Fed. Cir. 1998).

⁷ *Ex parte Gerlach and Woerner*, 212 USPQ 471 (PTO Bd. App. 1980).

⁸ See MPEP §2143.01, citing *Al-Site Corp. v. VSI Int'l Inc.*, 50 USPQ2d 1161 (Fed. Cir. 1999).

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wafer...and directing EUV energy on said defect region and removing a substantial portion of said defect", as recited in independent claim 9, as amended.

Still further, the applied art, taken alone or in combination, does not teach or suggest a method of repairing a defect on a mask which includes, among other features, "providing a reflective substrate comprising the mask which includes a first region and a second region...shining a plurality of EUV laser pulses on said defect region to ablate said defect after selecting a pulse duration of said laser pulses...", as recited in independent claim 16, as amended.

Finally, the applied art, taken alone or in combination, does not teach or suggest a method of removing material from a reflective substrate which includes, among other features, "...providing a reflective substrate having a region with a non-reflective or absorbing material thereon; [and] shining a plurality of EUV laser pulses on said non-reflective or absorbing region to remove said material without damaging said reflective substrate underlying said material", as recited in independent claim 23, as amended.

Accordingly, since the applied art does not teach or suggest all the claimed limitations of independent claims 1, 9, 16, and 23, withdrawal of the rejections and allowance of claims 1-48 are requested.

Procedural Deficiency in the Official Action

Applicants note that the official action fails to consider the various dependent claim features, and their various chains of multiple dependency.

Applicants submit that the dependent claims 2-8, 10-15, 17-22, 24-42, and 44-48 are separately patentable in their own right, without reliance upon the allowability of the independent claims discussed above.

For example, the applied art does not teach or suggest the method of dependent claim 4, "wherein said tuning includes tuning the wavelength of the laser pulses to approximate a peak reflection wavelength of the substrate." The Official Action is silent on this claim limitation.

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As another example, the applied art does not teach or suggest the "method of any one of claims 4, 9, 13, 14, 16, and 23, wherein said substrate is reflective in a region of light from 1 nm to 10 nm", as recited in multiple dependent claim 37. This aspect of the embodiment represents the EUV or VUV range, for which the applied art is particularly silent, since Applicants have broken new ground in the photomask repair field by their novel and non-obvious invention directed in some embodiments to the repair of reflective photomasks using EUV laser pulses.

Accordingly, Applicants respectfully request a full examination on the merits of each of the dependent claims, in particular, an examination that accounts for the various chains of dependencies of the multiple dependent claims.

Conclusion

In view of the above amendment and remarks, applicant believes that each of pending claims 1-48 in the pending application is in immediate condition for allowance. An early indication of the same would be appreciated.

In the event that the Examiner believes that an interview would serve to expedite resolution of any outstanding issue in this application, the undersigned attorney is available at the telephone number indicated below.

Applicants believe that no fee is due with this response. However, if a fee is due, please charge CBLH Deposit Account No. 22-0185, under Order No. 20140-00303-US1, from which the undersigned is authorized to draw.

Respectfully submitted,

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Attachment: As stated